Amendments to the Specification:

Please replace the paragraph beginning at page 2, line 1 and ending at page 2, line 4 with the following amended paragraph:

This application is related to a patent application of Markus Kaufmann et al., filed on the same date as this application, entitled Method for Creating Single 3D Surface Model from A Point Cloud, serial no. <u>10/626,795</u> ———————————, the entire contents of which are incorporated by reference herein.

Please replace the paragraph beginning at page 13, line 2 and ending at page 13, line 16 with the following amended paragraph:

Figure 1 is a schematic diagram of one possible environment in which the invention can be practiced. A scanner 10 consisting of an optical probe unit 12 and scanner electronics module 14 conducts a 3D scan of an object 16. The object 16 can be virtually anything. In the present example the object 16 consists of <u>a</u> dentition. ~~15 and associated anatomical structures (gingival tissue) 17.~~ The scan of the dentition and gum tissue could be obtained either *in-vivo*, or it could be made from a physical model of the dentition and associated anatomical structures. The present invention is not limited to the particular manner in which the virtual model of the dentition and gingival tissue is obtained. For example, the scanner could be a laser scanner or destructive scanner. In the illustrated embodiment, the scanner is a hand-held in-vivo scanner as described in the published PCT application of OraMetrix, publication no. WO 01/80761, the contents of which are incorporated by reference herein. An opaquing solution may be applied to the surface to the dentition to enhance the ability to scan an objection in a "wet-field" environment, as taught in the patent application of Nancy Butcher et al., serial no. 10/099,042, filed March 14, 2002, <u>now issued as U.S. Pat. 6,854,973,</u> the contents of which are incorporated by reference herein.

Please replace the paragraph beginning at page 27, line 1 and ending at page 27, line 14 with the following amended paragraph:

Again, in the case of the initial or first open edge, block 220 will be answered in the negative, and so the process reverts to block 224. Here, a test is made to see if there are points in the point cloud to generate a new vertex. The block 224 is described below in conjunction with Figure 10A. If so (and this will ordinarily be the case at the beginning of the procedure), the process proceeds to block 226. At this block, a new point is generated using the weighted average procedure described above, see Figures 4A, 4B and 6, and a new triangle is constructed from the new vertex and the open edge selected at block 206. The points list is then updated, in that the points used in the weighting process to form the new vertex are marked as having been used and are not used in further modeling. The processing proceeds to block 212, where the list of open edges is adjusted to add the two new open edges created by the new triangle. If, at block 224, there are no further points in the point cloud to generate a new vertex adjacent to the open edge in question, the process reverts back to step 214, where a test is conducted to see if there are other open edges that have not been tried by processing through the modules 208, 216, 220 and 224. If block 220 is answered in the positive, then the process proceeds to the block 222 where a triangle is built between this point and the current open edge and the process reverts to the block 212.

Please replace the paragraph beginning at page 27, line 22 and ending at page 28, line 2 with the following amended paragraph:

If, at module 214, there are no untested open edges remaining, the process reverts to step 202 to see if there are points in the point cloud that have not been tested. If there are points in the points list that have not been tested, a new starting edge is selected in a new part of the point cloud (as indicated at step 204) and the processing of Figure 10 repeats for the new region in the point cloud (for example, where there are "floating"

regions). On the other hand, if the answer is negative at step 202, then the process is
finished at the block 228.

**Please replace the paragraph beginning at page 30, line 1 and ending at page 30, line
17 with the following amended paragraph:**

The first criterion will be explained in conjunction with Figures 10C and 10D.
Each point in the point cloud has a surface normal, defined as a vector extending from the
point in a direction normal to a weighted average of the triangle surfaces containing the
point (the triangles here are triangles constructed from the source data, not in the single
mesh surface). Within each frame of data forming the cloud, the data points are
triangulated in a way such that points, which are next to each other in the frame, are
connected by a triangle, An example of this is shown in Figure 10C. The points 254 in
the individual frame form a surface 252.   The lines 256 extending from the points 254
are a weighted average of the normal vectors (not shown) of the adjacent triangles that
include each point. Figure 10D, part A, shows a situation where the surface normal
vectors [[356]]256 of the points 254 in the set C are all relatively closely aligned. This
indicates that there is relatively little surface curvature. If the variation in the surface
normal vectors 256 is less than a threshold, the vertex selected from the set of points 254
passes the first criteria.   Figure 10D, part B, shows the situation where there is a large
degree of variation in the surface normal vectors, indicating a large degree of curvature in
the surface.   In this situation, the vertex selected from the points in Figure 10D, part B,
would be rejected.

Please replace the paragraph beginning at page 30, line 18 and ending at page 31, line 11 with the following amended paragraph:

The second criteria in Figure 10A, block 236, is a test of the angle between the existing triangle having the open edge <u>and</u> the new triangle constructed between the open edge and the newly selected vertex.   This angle must be less than a threshold value in order for the vertex to satisfy the selection criteria.   As shown in Figure 10E, part 1, an exiting triangle (shown on edge) has open edge 260, wherein the source data points 254 indicate little surface curvature. The triangle has a surface normal vector 262.   If the source data points 264 are used to construct a new triangle , the triangle would have a new vertex 268 and a surface normal vector 266. The angle γ between the triangles is greater than the threshold and thus vertex 268 will be rejected.   The processing of Figure 10A indicates a rejection at 238 and the processing proceeds to block 240, where the value of ϵ in the equations for C and W are reduced.   The process looks at points closer to the open edge and results in a selection of a new vertex 273, forming a triangle with edge 270 and new surface normal 272 having an angle $\gamma 1$ relative to the vector 262 as shown in Figure 10E. The angle $\gamma 1$ is less than the threshold so the new vertex 273 is accepted. [[The]] <u>Further</u> processing results in a new vertex 275 being selected <u>forming a triangle with edge 274</u>, in which the angle $\gamma 2$ between the new surface normal 276 and the normal vector 272 is also less than the threshold.   Thus, the process shown in Figures 10 D and 10E insure that the new vertex is chosen that minimizes deviation from the point cloud, and more specifically corresponds to the localized curvature represented by the points 264.

Please replace the paragraph beginning at page 34, line 22 and ending at page 35, line 6 with the following amended paragraph:

The processing continues with a step 310 of determining the location of saddle points in the virtual model and a step 312 of determining the position of the saddle points along a dental arch form, which makes use in one embodiment of a parabolic coordinate transform. The order in which steps 310 and 312 execute are interchangeable, as will be understood from the following description. The processing continues with a step 314 of performing an automatic area search. This procedure is shown in Figure 14, and invokes sub-routines shown in Figures 15 and 16. Subsequently, the process is finished at step 316. The result of the process is an identification in the model of the tooth crowns, and associated gingival tissue, the primary objective of the present invention. The processes shown in Figure 11 will now be described in detail in the following sections.

Please replace the paragraph beginning at page 35, line 9 and ending at page 35, line 14 with the following amended paragraph:

The aim of this procedure 304 is to perform a transformation T_V which spatially positions the cloud of points (or single mesh surface or other form in which the data is represented) in such a manner that the plane of occlusion approximately corresponds to the plane of the x-y coordinates, the "center of gravity" of the of the arch is [[being]] near the z coordinate axis and the opening of the palatomaxillary arch is pointing in the direction of the positive y coordinate.

Please replace the paragraph beginning at page 36, line 1 and ending at page 36, line 5 with the following amended paragraph:

In a first step 320 in process 304, a first approximation of an up vector and center point is made. The up vector is the mean of the normals of all vertices, which gives a rough approximation of the up vector (the vector that is transformed into the positive z coordinate by T_V). The mean of all X, Y, Z coordinates of all points in the model forms the first rough approximation of the center point C ("center of gravity" of the arch).

Please replace the paragraph beginning at page 40, line 21 and ending at page 41, line 10 with the following amended paragraph:

The flow chart of Figure 13 shows the process 308 as including step 340, determining whether there is a point in the surface which has not been passed yet in the traversal of the triangle edges. If so, at step 342 a check is made to see if the point has a neighbor with a greater Z value. If so the process proceeds to step 344 and the search continues to the next adjacent point with a greatest Z value, and processes 342 and 344 continued until a local maximum is reached. Once the local maximum is reached, block 342 is answered in the negative, and so the point is marked as a local maximum at step 346 and the process proceeds to step 348 were all the points that were passed in steps 342 and 344 are marked as belonging to the "catchment area", the area bounded by the local maximum. The process reverts back to step 340, another available point is selected, and the process continues until all points have been tested, at which the process finishes, as indicated at step 350. The resulting maxima 500 are shown in Figure 18. The catchment areas for the local maxima are given different shading, including areas 502, 504, 506, 508, 510, etc. Each local maximum has one and only one catchment area.